Kinetic and Mechanistic Study of Methanol Oxidation on the Carbon Supported Pt and Pt/Ru Catalysts

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The methanol oxidation reaction on carbon supported Pt and Pt/Ru catalysts covered by Nafion film at a glassy carbon rotating disc electrode has been studied. The catalyst was prepared according to the procedure proposed by Schmidt at al [1]. The electrode was immersed under potentiostatic control in nitrogen purged electrolyte (0.5 M H2SO4, Merck p.a.). The base voltammograms of Pt and Pt/Ru supported electrodes (15 mg/cm2 of metals), shown in Figs 1 and 2 were recorded after cycling several times between 0.05-1.4 (1.1) V vs. RHE in order to produce the clean surface and to check the quality of catalysts. Analyzing the hydrogen oxidation reaction in H2 saturated electrolyte it has been concluded that mass transport limitations imposed by the Nafion film was negligible. After H2 was purged from the electrolyte, the different concentration of methanol (0.1-0.5 M), by injection in the electrolyte, was prepared. The electrode was hold at 0.05 V vs RHE for 3 min before the anodic slow sweep (1 mV/s) polarization measurement was performed. Tafel plot for methanol oxidation reaction is shown on Fig. 3. The mass specific activity (mA/mg) was obtained by procedure given in [1]. One can see that Pt/Ru catalyst is better catalyst for methanol oxidation up to the 650 mV vs RHE, even at the room temperature. It should be mentioned that Tafel slope of 120 mV/dec for Pt supported electrode was the same for a single crystal Pt(111) surface in acid and alkaline solutions [2, 3]. For Pt(111) was suggested that the chemical reaction between the methanol adsorbed radical, produced by dehydrogenation of methanol, and Pt-OHads species, generated by water discharge, could be the rate determining step [3]. From the determined kinetics parameter (Tafel slopes, methanol reaction order, ect.) and effect of temperature the mechanism of methanol oxidation reaction on Pt and Pt/Ru supported catalyst has been discussed.

References

[1] T.J.Scmidt, H.A. Gasteiger, G.D. Stab, P.M. Urban, D.M. Kolb, R.J. Behm, J.Electrochem.Soc 145, 7 (1998)2354 [2] A. Tripkovic, K. Popovic, Electrochim. Acta., 41(1996)471 [3] A. Tripkovic, K. Popovic, Momcilovic, D.Drazic, J.Electroanal. Chem., 418(1996)20